Synopsis of the thesis

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QUATERNARY GEOLOGY AND GEOMORPHOLOGICAL ANALYSIS OF THE GIRNA RIVER SUB-BASIN, NORTH MAHARASHTRA, INDIA

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Abstract:

In the present, Quaternary geological geomorphological investigation is considered to be executing in the Girna river sub-basin in North Maharashtra. The study is intended to derive the data on various aspects of geology such as, structures of Deccan volcanic province, alluvial plane and Quaternary sediments. On the basis of Morphometric parameter we specify and understanding the evolution of landform and study of morphometry by using GIS platform and data set processing statistically. The morphometric parameter of Girna river are intended to understand the general trend of the sub-basin with reference to the tectonic or neotectonic control. The morphmetric study combined with GIAT (Geomorphic Indices for Active Tectonic) parameters will be used to search the abnormal behavior of basin and neotectonic activity if any. The present study will be helpful for systematically describe the geology, Quaternary sediments, geomorphology, structure and neotectonic attribute of the river sub-basin.

Introduction

The evolution of landform are most remarkable characteristics of earth surface and this study undertaken branch of geomorphology and it generally included the genesis and evolution of surface features of the earth. “In other word geomorphology is the science of landform. The landform feature in the Earth crust reflects endogenic process, which is active beneath the crust and the mantle. The endogenic (internal) processes on earth crust are responsible for formation some geological structure such as dyke, folds, fault, lineament, joint and lava flows. Due to physical, chemical and biological weathering and erosion process, the sediments are transported and deposited for development of landform. The thorough geomorphic study and geological mapping of the area is intended to study the stratigraphic position of the Girna river, a tributary of Tapi river. Sediment is remarkable feature on the earth surface and the study of sediment carried with branch of Quaternary geology, it gives detailed information of geological history of the area and its depositional environment.

Previously, lots of study has been carried out on geology and hydrogeology by different researcher, but very little work done on floodplan, alluvial plane and river terraces of Girna river sub-basin. In the present study Quaternary geological mapping is done on the basis of soil stratigraphy, morphostratigraphy and lithostratigraphy. Girna river geographically flow through the Nashik, Aurangabad and Jalgaon district of Maharashtra. Geologically, the area is occupied by the Deccan basalt and Quaternary alluvial plane.

1. Review of Literature

Earlier the manual techniques have been used to calculate the geometry of the landform (Hortan, 1945; Miller, 1953; Coates, 1958). By using toposheets, measuring the geomorphic parameter are very time consuming. In 1960s and early 1970s, the availability of computers made it possible to identify landform characteristic based on statistical methods (Chorley, 1972; Evans, 1972). Now days the research based on the geomorphometric analysis is based on the GIS techniques in association with the satellite data made it easier and covering the large and vast areas.

The fluvial geomorphology is joint with part of river form morphology and landform on the earth and as such it is concerned with the time bound approach toward the geomorphology (Davis 1899). The morphometric analysis is the first step to quantitatively geomorphological study. Hortan (1932) is first parson to study the landform, quantitative morphometric parameter, later this morphometric study of landforms is done in more detail by Horton (1945), Strahler (1952, 1956, 1957 and 1964), Miller (1953), Chorley (1957), Schumm (1956), Hack (1973), Cannon (1976), Shreve (1969), Cox (1994) and Schumm and Spitz (1996).

The present study area is covered by Deccan Basalts and alluvial plane deposits. The Deccan Basalts and alluvial plane of Tapi River meet near Jalgaon (District Survey Report of Jalgaon 2019). Quantitative geology gives the information about past geological history and depositional environment. In India Geological Survey of India (GSI) and other institutes study the Quaternary deposits and geological mapping is carried out along the Ganga and Brahmaputra rivers in extra-peninsular India, Narmada, Son valley, Godavari and Krishna valley in peninsular India. Account of these study can be found in Oldham (1917), Pascoe (1965), Rajaguru (1969), Dikshit (1970), Corvinus et al (1973), Balasundaram (1977), Bhattacharya and Banerjee (1979), Ghosh and Mazumder (1981), Goswami (1993), Roy and Chattopadhyey (1997), Singh et al (2007), Babar (2000, 2002 and 2008), Chunchekar (2012), Ghute (2013) and Gurav (2020). The research on the Quaternary geology and Geomorphology is not found in the Girna river sub-basin. In recent years, the study of Quaternary geology and geomorphology assumed great significance and have been receiving attention of geologist.

In the present research work most of area is covered by Deccan basalt volcanic province along with alluvial sediments around the river sub-basin. There are two type of lava flow observed in the area namely ‘pahoehoe’ and ‘aa’ types. On the basis of appearance pahoehoe lava flows showing a characteristic of smooth or ropy lava structure Gadekar (2020). In Girna river tachyalytic basaltic band are common and it separate two lava flow (Salve (2011).

2. Objectives Proposed

1. To document qualitative geomorphology of the Girna River basin.
2. To study Geology and Geological Structure in Basaltic formation.
3. To analyze the Quaternary deposits along the Girna river in selected location.
4. To study neotectonic activity if any in the form of lineament pattern, kinks in the streambed and in the Quaternary sediments.

3. Methodology adopted

The following methodology will be adopted to work out geomorphic and Quaternary study of the Girna river sub basin.

1. The reviews of literature, articles and projects related to present area are to be studied for geology, structural and geomorphological data. It is used to understand the overall geologic setup of the area.
2. Extensive fieldwork will be undertaken in order to study the geology, geomorphology and Quaternary geology with the help of equipment brunton, clinometer compass, scale, toposheets, Geographical Positioning System (GPS) and Google Earth imagery.
3. The surface and sub-surface geology will be studied through open dug wells, road cut and trenches available.
4. The field kit for survey and related work comprised clinometer compass, GPS and measuring tape will be used to get the latitude, longitude of the location, elevation of the location and for the trend measurements of the rock formations respectively.
4. The Quaternary deposits of the Girna river valley are to be documented
5. In order to study the Quaternary deposits, the sediment samples have to be collected from different layers observed during the field visit. The Sieve analysis of these samples collected will be carried out in the laboratory.
6. Geomorphic surfaces are to be classified in various geomorphic units (Landforms) based on the topographic features, morphometric characteristics, slope analysis, satellite imagery and Google Earth imagery.
7. The synoptic view and multispectral nature of the satellite image will helps in identifying and mapping the lithological units. The geological mapping is to be carried out with reference to detailed fieldwork in the area and visual interpretation of satellite imagery along with geological map of Nasik, Aurangabad and Jalgaon district, Maharashtra Remote Sensing Application Centre (MRSAC) and GSI.
8. Synoptic view of satellite imagery facilitates better appreciation of geomorphology and helps in mapping of different landforms and their assemblages. The photo interpretation

criteria such as colour, tone, texture, pattern of drainage, shape and topography, nature of the rock and SOI toposheets are to be used to prepare geomorphologic map.

9. The detailed field work will undertaken in all the potential localities derived from the satellite data.

4. Importance of study

This study will bring out the geomorphology and Quaternary sediment which can give information of geological past and environment changes of Girna river sub basin. The morphotectonic study will be used to understand the evolution of Girna river neotectonically. The study area covers both Deccan basalt and alluvial plan it will help to understand geomorphologic changes in the drainage evolution and subsurface give the information on structure and development. The geomorphic parameter correlated with Quaternary sediment deposition will bring out the information on sedimentary sequences.

The findings of geomorphological analysis if come out with the distinctive results on bifurcation ratios, basin configuration, sinuosity parameters, valley development, drainage pattern and Quaternary sedimentary deposits, that will be useful to correlate the sedimentary sequence else were in Deccan peninsular India. The present research will be a useful document in order to study the Quaternary geology and geomorphic characteristic of the river basins in India. Furthermore, the studies on such feature would give the approaching of dimensions of Quaternary geological events. The present data would be a useful document with a potential wealth of information, which can be obtained from Quaternary sediments.

5. Expected Outcome from the Research

Although sporadic attempts are being made in the Quaternary geological and geomorphological studies of the Girna river sub-basins over Deccan Peninsula, the research work has not been systematically complied and streamlined from Quaternary stratigraphic point of view. The results of the present analysis (i.e. morphometric, sedimentary section analysis and morphotectonic study) will help in carrying out the similar studies in else were in India. The results of the research may be extrapolated to other areas of the Deccan Volcanic Province and may even serve as an example for replicating similar kind of studies in other regions as well.

6. References

1. Babar, Md. (2000). Quaternary Geology and Geomorphology of Purna river basin in Parbhani district, Maharashtra. Ph. D report submitted to the Swami Ramanad Teerth Marathwada University, Nanded, Maharashtra, India.
2. Babar, Md. (2005a). Remote Sensing and GIS Applications in Groundwater Targeting for Rural applications for Rural Development at NIRD, Hyderabad, pp. 204-213.
3. Babar Md., Kaplay R.D., Mukherjee S, Kulkarni P.S. (2017). Deformation of dykes from Central Deccan Volcanic Province, Aurangabad, Maharashtra, India. In: Mukherjee S, Misra AA, Calvès G, Nemčok M. (Eds) Tectonics of the Deccan Large Igneous Province: an introduction. Geological Society, London, Special Publications 445, http://doi.org/10.1144/SP445.13, pp. 337-353.
4. Balasundaram, M.S. (1977). Contribution to geomorphology and geohydrology of the Brahmaputra valley. Geol. Surv. India Misc. pub., no. 12.
5. Bhattacharya, A., Banerjee, S.N. (1979). Quaternary geology and geomorphology of Ajay-Bhagirathi valley, Birbhum and Murshidabad district, West Bengal. Indian, Journal of Earth Science, vol. 6(1), pp. 91-102.
6. Cannon, P. J. (1976). Generation of explicit parameters for quantitative geomorphic study of the Mill Creek drainage basin, Oklahome Geology Note, vol. 36(1), pp. 3-16 (Cross reff. Manjare, B.S., 2014).
7. Chorley R. J., (1972). Chapter 1-Spatial Analysis in Geomorphology. In Spatial Analysis in Geomorphology, *Chorley, R. J. (Ed) Harper and Row Publishers, New York, USA*, pp: 3-16 (Cross reff. Sermin et.al. 2008).
8. Chunchekar, R.V. (2012). Quaternary Geology and Geomorphology of Terna river basin, Eastern Maharashtra. Ph.D. thesis submitted to the Swami Ramanand Teerth Marathwada University, Nanded, Maharashtra, India
9. Coates D. R., (1958). Quantitative geomorphology of small drainage basins in Southern Indiana. *Columbia University, New York.* (Cross reff. Sermin et.al. 2008).
10. Corvinus, G., Rajaguru, S.N., Mujumdar, G.G. (1973). Some observations on the Quaternary formations of Western Maharashtra (India). Quaternary, vol. 23-24, pp. 53-69.
11. Cox, R.T. (1994). Analysis of drainage-basin symmetry as a rapid technique to identify Area of possible quaternary tilt-block tectonics: an example from the Mississippi embayment. Geol. Soc. Am. Bull. 106, pp. 571–581(Cross reff. Herlekar and Wavare, 2014).
12. Davis, W.N. (1899).The peneplain. In geographical essays edited by D.W. Johnson, Dover publication. INC. (1909), pp.350-380.
13. Dikshit, K.R. (1970). Polycyclic landscape and the surfaces of erosion in the Deccan Trap country with special reference to upland Maharashtra. The Nat. Geog. Jour. India, vol. 16, pp. 236-252.

14. District Survey Report of Jalgaon district 2020.
15. Evans I. S., (1972). General geomorphometry, derivatives of altitude, and descriptive statistics. In: Chorley RJ (ed) Spatial analysis in geomorphology. *Harper and Row, NewYork*, pp 17–90. (Cross reff. Praveen et. al. 2014).
16. Gadekar A.S. (2020). "Geomorphic Expressions of Dykes from the Manmad Area Nashik District, Maharashtra" M.Phil. thesis submitted to the Swami Ramanand Teerth Marathwada University, Nanded, Maharashtra, India.
17. Ghosh, R.N., Mazumder, S. (1981). Neogene-Quaternary sequence of Kasai basin, West Bengal, Indian Proc. Field Conf. Neogene-Quaternary boundary, India (edited by Sastri et al., 1981) Geol. Surv. India, pp. 63-73.
18. Ghute B.B. (2013). Quaternary geology and geomorphology of Godavari river in Parbhani district, Maharashtra. Ph. D. thesis submitted to the Swami Ramanand Teerth Marathwada University, Nanded, Maharashtra, India.
19. Gioia, D., Gallicchio, S., Moretti, M., Schiattarella, M., (2014). Landscape response to tectonic and climatic forcing in the foredeep of the southern Apennines, Italy: insights from Quaternary stratigraphy, quantitative geomorphic analysis, and denudation rate proxies. *Earth Surf. Process. Landf.* 39, 814–835. (Cross Reff. Manoj et al 2016).
20. Goswami, A.B. (1993). Review on Quaternary Geological Mapping and standardisation of scheme of classification for inter basin regional correlation of Quaternary landform and Geological units in East and North-East India. Geol. Surv. India, Rec. vol. 121, (Pt. 2-8), pp. 55-85.
21. Gurav C.A. (2020) Quaternary stratigraphy and geomorphology of Lendi river sub basin in west-central Maharashtra. Ph. D. thesis submitted to the Swami Ramanand Teerth Marathwada University, Nanded, Maharashtra, India.

22. Hack, J.T. (1973). Stream profile analysis and stream gradient index. U.S. Geol. Survey, vol. 1, pp. 421-429 (Cross reff. Herlekar and Wavare 2014).
23. Hodgkinson J. H., Mcloughlin S. & Cox M. (2006a). The correlation between physiography and neotectonism in southeast Queensland. *Proceedings of the Earthquake Engineering Conference AEES2006, Canberra*, pp. 195 – 202. (Cross reff. Hodgkinson et al 2007).
24. Horton, R.E. (1932). Drainage basin Characteristics, Trans. Amr. Geophy. Union, vol. 13, pp. 350-361 (Cross reff. Herlekar and Wavare 2014).
25. Horton R. E., (1945). Erosional development of streams and their drainage basins; hydrophysical approach to quantitative morphology. *Bull Geol. Soc. Am.* 56:275–370. (Cross reff. Praveen et. al. 2014).
26. Jain,P. K. and Gupta, D. C.,(2013) Geochemistry of intrusive rock of Deccan trap region around Manmad Nashik India.ISSN 2321 – 9149Research Article IJAEES (2013) Vol.1, No.1, 1-13.

27. Medlicott, H.B. (1865). Geological notes on Assam and the hill to the south. Mem. Geol. Surv. India, vol. 4. pt. 3, pp. 416-442.
28. Medlicott, H.B. (1873). The plains of the united provinces. Rec. Geol. Surv. India, vol. 6(1), pp. 58-87.
29. Miller J. C. (1953). A quantitative geomorphic study of drainage basin characteristics in the cinch mountain area. Virginia and Tannessee. *Technical Report 3*. (Cross reff. Sermin et.al. 2008).
30. Oldham, R.D. (1917). Structure of Gangetic plains. Mem. Geol. Surv. India, no 42, p. 2.O.
31. Pascoe, E.H. (1964). A Manual of the Geology of India and Burma. Govt. of India Press, G.S.I, Calcutta, 3rd edition, vol. 1, pp. 1-485. (Cross reff. Herlekar and Wavare, 2014).
32. Rajaguru, S.N. (1969).On the Late Pleistocene of the Deccan Quaternaria, XI Roma, pp. 241-253.
33. Roy, R.K., Chattopadhyay, G.S. (1997). Quaternary geology of the Environs of Ganga delta, West Bengal and Bihar. Indian J. Geology, vol. 69 (2), pp. 177-209.
34. Salve P.L. (2011). Geohydrological Studies of Deccan Basalt in Girna Sub Basin, District Jalgaon. (M. S.) India. PH.D Thesis Submitted to the Dr. BabaSaheb Ambedkar Marathwada University, Aurangabad (M. S.) India.
35. Schumm, S.A. (1956). Evolution of drainage system and slope in Badlands at perth Amoboy, New Jersey, Geological Society of America, Bulletin, vol.67, pp.97-646 (Cross reff. Herlekar and Wavare, 2014).
36. Schumm, S.A., Spitz, W.J. (1996). Geological influences on the lower Mississippi river and its alluvial valley. Engineering Geology, vol. 45, pp. 245-261.
37. Shreve R.W. (1969) Stream lengths and basin areas in topologically random channel networks. J Geol 77, pp. 397-414.
38. Singh, A.D., Nisha, N.R., Ramachandran, K.K. (2007). Late Quaternary Evolution of the shelf Environment of North Kerala: faunal and sedimentalogical Evidences. Joul. Of Geological Society of India. Vol. 70, pp. 109-120.
39. Strahler, A. N., (1952). Hypsometric (area-altitude) analysis of erosional topography. *Geological Society of America Bulletin 63*, 1117e1142. (Cross reff. Praveen et. al. 2014).
40. Strahler A.N. (1957). Quantitative analysis of watershed geomorphology. Trans. Am. Geophys. Union. 38, pp. 913-920 (Cross reff. Herlekar and Wavare, 2014).
41. Strahler A.N. (1964) Quantitative geomorphology of drainage basins and channel networks. In: Chow VT (ed) Handbook of applied hydrology. McGraw-Hill, New York, pp. 439-476 (Cross reff. Herlekar and Wavare, 2014).

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